AMENDMENTS TO THE CLAIMS

Please amend the claims as follows. Please cancel claim 24 without prejudice.

1. (Previously presented) A waveshaping circuit that shapes a first waveform to decrease a ratio of peak power to average power in the first waveform such that an available power of a radio frequency power amplifier can be efficiently used, where the shaping of the first waveform is substantially free from spectral pollution, the waveshaping circuit comprising:

a preconditioning circuit adapted to receive an input symbol stream, the preconditioning circuit configured to compare data in the input symbol stream to a first reference and to modify the data in the input symbol stream by applying a first impulse to the input symbol stream selected to at least partially reduce the magnitude of a signal peak in the first waveform when the input symbol stream exceeds the first reference, the preconditioning circuit further configured to provide the modified symbol stream to a pulse-shaping filter, which maps the modified symbol stream to a baseband stream, where the pulse-shaping filter is configured to provide the baseband stream to a mixer, which upconverts the baseband stream by multiplication with an oscillator signal from a digital numerically controlled oscillator to an upconverted signal;

a pulse generator adapted to receive the upconverted signal and to receive phase information from the digital numerically controlled oscillator, the pulse generator configured to generate a band-limited pulse when the pulse generator detects that the upconverted signal has a signal crest above a predetermined threshold, where the band-limited pulse is substantially limited to a frequency band allocated to the input symbol stream;

a delay circuit configured to delay the upconverted signal to generate a delayed upconverted signal, where an amount of delay is approximately equal to a latency in the pulse generator; and

a summing circuit adapted to sum the band-limited pulse from the pulse generator with the delayed upconverted signal from the delay circuit to generate the first waveform.

2. (Original) The waveshaping circuit as defined in Claim 1, wherein the band-limited pulse is selected from the group consisting of a band-limited Gaussian pulse, a band-

limited Square Root Raised Cosine (SRRC) pulse, a band-limited Raised Cosine (RC) pulse, and a band-limited Sinc pulse.

3. (Original) The waveshaping circuit as defined in Claim 1, wherein the pulse generator further comprises:

a comparator adapted to detect when the upconverted baseband stream has a signal crest above the predetermined threshold;

an impulse generator adapted to provide a second impulse in response to an indication from the comparator that the signal crest is above the predetermined threshold;

a weight generator that provides a weight value to scale a magnitude of the second impulse; and

a finite impulse response (FIR) filter configured to filter the second impulse to substantially limit the second impulse to a frequency band allocated to the input symbol stream.

4. (Original) The waveshaping circuit as defined in Claim 1, wherein the preconditioning circuit is configured to receive updates to vary the first reference, and where the pulse generator is configured to receive updates to vary the predetermined threshold.

5. (Original) The waveshaping circuit as defined in Claim 1, where the input symbol stream comprises a plurality of input symbol streams, which are processed by the preconditioning circuit, pulse-shaped, upconverted and combined to the upconverted baseband stream, and where the band-limited pulse generated by the pulse generator is substantially limited to a frequency band allocated to an input symbol stream from the plurality of input symbol streams.

6. (Original) The waveshaping circuit as defined in Claim 5, further comprising a predictive weight generator circuit coupled to the plurality of input symbol streams and to a plurality of digital numerically controlled oscillators that are used to upconvert pulse-shaped input symbol streams, the predictive weight generator circuit configured to at least partially disable the preconditioning circuit and the pulse generator in real time in response to a prediction that the plurality of input symbol streams at least partially destructively interfere in the combined upconverted baseband stream.

7. (Original) The waveshaping circuit as defined in Claim 1, where the input symbol stream comprises a plurality of input symbol streams, which are processed by the preconditioning

circuit, pulse-shaped, upconverted and combined to the upconverted baseband stream, and where the band-limited pulse generated by the pulse generator comprises a plurality of band-limited pulses, which are applied to the combined upconverted baseband stream to destructively interfere with the signal peak, where each of the plurality of band-limited pulses corresponds to a frequency band allocated to an input symbol stream from the plurality of input symbol streams.

8. (Canceled)

9. (Canceled)

10. (Previously presented) A preconditioning circuit adapted to reduce an amplitude of a signal peak in an input symbol stream in real time, where an output of the preconditioning circuit is applied to a pulse-shaping filter, the preconditioning circuit comprising:

a comparator coupled to the input symbol stream to compare a symbol from the input symbol stream to a reference level, the comparator configured to generate a correction vector in response to the symbol exceeding the reference level;

a pseudo random sequence generator adapted to generate a pseudo random noise sequence;

a weight generator coupled to the comparator and to the pseudo random sequence generator, the weight generator configured to provide a weight factor based on the correction vector and the received pseudo random noise sequence;

a first delay circuit coupled to the pseudo random sequence generator, where the first delay circuit is adapted to delay an impulse from the pseudo random sequence generator by a time approximately equal to a latency in the weight generator;

a multiplier circuit coupled to the first delay circuit and to the weight generator, where the multiplier circuit is configured to multiply an impulse from the first delay circuit with a corresponding weight factor from the weight generator in order to select the impulse from the pseudo random noise sequence and to scale the selected impulse;

a second delay circuit coupled to the input symbol stream, where the second delay circuit is configured to delay the input symbol stream by a time approximately equal to a latency in the comparator, the weight generator, and the multiplier circuit; and

a summing circuit coupled to the multiplier circuit and to the second delay circuit, where the summing circuit is configured to sum the impulse selected and scaled by the

multiplier circuit with the input symbol stream from the second delay circuit to generate the output of the preconditioning circuit.

11. (Original) The preconditioning circuit as defined in Claim 10, wherein a value of the weight factor generated by the weight generator includes positive values, negative values, zero, and complex numbers.

12. (Original) The preconditioning circuit as defined in Claim 10, wherein the comparator is configured to receive adaptive updates to the reference.

13. (Original) The preconditioning circuit as defined in Claim 10, wherein the preconditioning circuit is adapted to at least decrease an amount of the impulse selected and scaled by the multiplier circuit in response to a prediction of destructive interference to a signal peak in a composite waveform that includes pulse-shaped and upconverted from the input symbol stream.

14. (Original) The preconditioning circuit as defined in Claim 10, wherein the preconditioning circuit is adapted to at least decrease an amount of the impulse selected and scaled by the multiplier circuit in response to a prediction of destructive interference to a signal peak in a composite waveform that includes pulse-shaped and upconverted from the input symbol stream.

15. (Original) The preconditioning circuit as defined in Claim 10, wherein the comparator further comprises:

a magnitude computation circuit adapted to compute a magnitude of the input symbol stream;

a Taylor series approximation circuit adapted to compute a Taylor series expansion of a nonlinear weighting function with the computed magnitude as an input;

a delay circuit adapted to delay the input symbol stream by a time substantially equal to latency in the magnitude computation circuit and the FIR filter; and

a mixer adapted to multiply a filtered output of the FIR filter with the delayed input symbol stream from the delay circuit.

16. (Previously presented) A digital waveshaping circuit that decreases an amplitude of a selected portion of a composite multicarrier signal in real time, where the composite multicarrier signal includes a plurality of input symbol streams that have been pulse-shaped and

frequency up-converted, where the decrease in amplitude of the selected portion allows a power capability of a related radio frequency amplifier to be more efficiently used, the digital waveshaping circuit comprising:

means for monitoring the plurality of input symbol streams that eventually combine to form the composite multicarrier signal;

means for monitoring phases of a plurality of carriers from a plurality of digital numerically controlled oscillators (NCOs), where the plurality of oscillator signals are mixed with a plurality of pulse-shaped input signal streams to upconvert the plurality of pulse-shaped input signal streams;

means for monitoring the composite multicarrier signal to identify a signal peak above a selected threshold;

means for determining a first symbol stream's contribution to the detected signal peak in the composite multicarrier signal;

means for generating at least a first band-limited pulse selected to destructively interfere with at least a portion of the identified signal peak, where the first band-limited pulse is substantially limited to a frequency band allocated to the first symbol stream; and

means for combining the composite multicarrier signal with the at least one band-limited pulse to reduce the signal peak.

17. (Previously presented) A method of shaping a first waveform to decrease a ratio of peak power to average power in the first waveform by digitally modifying data in a data stream that gives rise to the first waveform, where the shaping of the first waveform is substantially free from spectral pollution, the method comprising:

comparing data in an input symbol stream to a first reference;

modifying the input symbol stream by applying an impulse to the input symbol stream selected to at least partially reduce the magnitude of a signal peak in the first waveform when the comparing indicates that corresponding data in the input symbol stream exceeds the first reference;

providing the modified input symbol stream to a pulse-shaping filter, which maps the modified input symbol stream to a baseband stream, where the baseband stream is upconverted by a mixer and a carrier information stream to an upconverted stream;

comparing the upconverted stream to a second reference; and

generating the first waveform by applying a band-limited pulse to the upconverted stream selected to at least partially reduce the signal peak in the upconverted stream when the comparing indicates that at least a portion of the upconverted stream exceeds the second reference, where the band-limited pulse is substantially limited to a frequency band allocated to the input symbol stream.

18. (Original) The method as defined in Claim 17, wherein the band-limited pulse is a band-limited Gaussian pulse.

19. (Original) The method as defined in Claim 17, wherein the impulse applied to the input symbol stream is selected by applying weight values to a sequence of pulses from a pseudo-random sequence generator.

20. (Original) The method as defined in Claim 17, wherein a size of the impulse applied to the input symbol stream and a size of the band-limited pulse applied to the upconverted stream are under adaptive control.

21. (Original) The method as defined in Claim 17, wherein the input symbol stream is an input symbol stream in a plurality of input symbol streams, where the plurality of input symbol streams are pulse-shaped to a plurality of baseband streams, where the plurality of baseband streams are upconverted by multiple carriers to upconverted streams, where the upconverted streams are combined to a composite stream, where at least one band-limited pulse is applied to the composite stream to destructively interfere with the signal peak, where the at least one band-limited pulse corresponds to a frequency band allocated to an input symbol stream from the plurality of input symbol streams.

22. (Original) The method as defined in Claim 21, wherein the at least one band-limited pulse comprises a plurality of band-limited pulses applied to the composite stream to destructively interfere with the signal peak, where each of the plurality of band-limited pulses corresponds to a frequency band allocated to an input symbol stream from the plurality of input symbol streams.

23. (Original) The method as defined in Claim 21, further comprising:

predicting a level of the composite stream;

comparing the predicted level of the composite stream to a predetermined threshold;

reducing, in real time, an amount of the impulse applied to the input symbol stream when the predicted level of the composite stream is below the predetermined threshold; and

reducing, in real time, an amount of the at least one band-limited pulse applied to the composite stream.

24. (Canceled)

25. (Currently amended) The method as defined in ~~Claim 24~~ Claim 26, wherein the method is not performed in real time.

26. (Currently amended) ~~The method as defined in Claim 24,~~ A method of adaptively controlling a digital waveshaping process, the method comprising:

receiving reference information as a control input, wherein the reference information is applied as a control parameter to a non-linear function that controls a hardness of limiting~~, the method further comprising~~;

monitoring at least one input symbol stream applied to the waveshaping process;

monitoring an output of the waveshaping process, where the output includes a waveform that is pulse-shaped and upconverted from the at least one input symbol stream;

updating a first parameter used to select an impulse that is applied to the input symbol stream to at least partially reduce the magnitude of a signal peak in the output of the waveshaping process;

updating a second parameter used to select a band-limited pulse that is applied to the output of the waveshaping process; and

calculating the first parameter and the second parameter to achieve the limiting as specified by the non-linear function.

27. (Currently amended) ~~The method as defined in Claim 24,~~ A method of adaptively controlling a digital waveshaping process, the method comprising:

receiving reference information as a control input;

monitoring at least one input symbol stream applied to the waveshaping process;

monitoring an output of the waveshaping process, where the output includes a waveform that is pulse-shaped and upconverted from the at least one input symbol stream;

updating a first parameter used to select an impulse that is applied to the input symbol stream to at least partially reduce the magnitude of a signal peak in the output of the waveshaping process;

updating a second parameter used to select a band-limited pulse that is applied to the output of the waveshaping process; and

wherein the at least one input stream comprises a plurality of input streams, which are pulse-shaped, upconverted, combined, and waveshaped to generate the output.

28. (Original) A method of digitally preconditioning an input symbol stream to a pulse-shaping filter in real time, the method comprising:

comparing a symbol from the input symbol stream to a reference;

generating a weight value in response to the comparison between the symbol and the reference;

receiving a pseudo random sequence;

multiplying an impulse from the pseudo random sequence with the weight value to generate a correction impulse; and

summing the correction impulse with the symbol.

29. (Original) The method as defined in Claim 28, wherein the weight value includes zero.

30. (Original) The method as defined in Claim 28, wherein the weight value can take on positive values, negative values, zero, and complex numbers.

31. (Original) The method as defined in Claim 28, further comprising adaptively updating the reference.

32. (Original) The method as defined in Claim 28, wherein the input symbol stream comprises a plurality of input symbol streams and the preconditioning is applied to the plurality of input symbol streams, the method further comprising decreasing a magnitude of the correction impulse in response to a prediction that a peak level of a composite signal is less than a

predetermined threshold, where the composite signal is generated by pulse-shaping, frequency upconverting, and combining of the plurality of input symbol streams, and where the predicted peak level is computed without preconditioning applied to the plurality of input symbol streams.

33. (Original) The method as defined in Claim 28, wherein the input symbol stream comprises a plurality of input symbol streams and the preconditioning is applied to the plurality of input symbol streams, the method further comprising disabling application of the correction impulse in response to a prediction that a peak level of a composite signal is less than a predetermined threshold, where the composite signal is generated by pulse-shaping, frequency upconverting, and combining of the plurality of input symbol streams, and where the predicted peak level is computed without preconditioning applied to the plurality of input symbol streams.

34. (Original) The method as defined in Claim 28, further comprising:

computing a magnitude of data in the input symbol stream;

applying the magnitude to a Taylor series expansion of a nonlinear weighting function; and

multiplying a result of the Taylor series expansion with the data in the input symbol stream to provide the preconditioning to the input symbol stream.

35. (New) The method as defined in Claim 27, wherein the method is not performed in real time.